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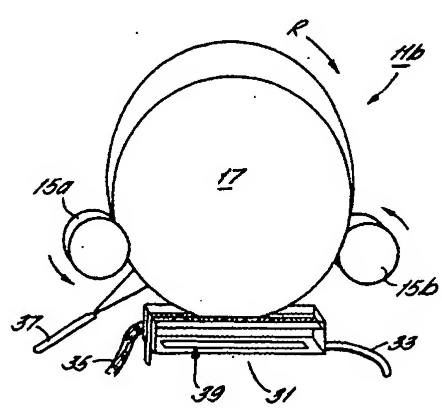
(54) **Wafer edge cleaning method and apparatus**

(57) A method and apparatus is provided for removing material from the edge of a disk. In one embodiment, the edge of the disk is contacted with etchant via an etchant containing swab or trough (which may contain one or more transducers) and is rotated such that successive portions of the disk edge are scanned through the trough or past the swab. To prevent etchant from contacting the major surface of the substrate, and/or to prevent excessive etching, the edge of the disk is contacted with a rinsing fluid (e.g., a rinsing fluid nozzle or a trough filled with rinsing fluid). In a further embodiment material such as residue or particles may be removed via a trough containing sonically energized rinsing fluid.

FIG. 2.



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Description

[0001] The present invention relates generally to apparatuses and methods for cleaning thin discs, such as semiconductor wafers, compact disks, and the like. More particularly, the invention relates to removing material (such as processing residue or deposited material) from the edge of a thin disk.

[0002] To manufacture a thin disk such as a semiconductor wafer, an elongated billet of semiconductor material is cut into very thin slices, about 1/2 mm in thickness. The slices or wafers of semiconductor material are then lapped and polished by a process that applies an abrasive slurry to the wafer's surfaces. Likewise, polishing processes are employed to planarize layers deposited on the wafer during device formation. After polishing, slurry residue is generally cleaned or scrubbed from the wafer surfaces via mechanical scrubbing devices, such as polyvinyl acetate (PVA) brushes, brushes made from other porous or sponge-like material, or brushes made with nylon bristles. Although these conventional cleaning devices remove a substantial portion of the slurry residue which adheres to the wafer edges, slurry particles nonetheless remain and may produce defects during subsequent processing.

[0003] In addition to slurry particles, other sources of edge residue/particles also exist. For example, during metal film deposition, a clamp ring typically is employed to secure a wafer to a heated pedestal within the deposition chamber and to shield wafer edges from film disposition (e.g., to prevent metal from depositing along wafer edges and shorting subsequently formed devices). Because the wafer and the clamp ring possess different coefficients of thermal expansion, each expands at a different rate during metal film deposition, the shear force between the clamp ring and the wafer's edge also may generate edge particles that serve as a defect source. Additionally, if the clamp ring surface does not make intimate contact with the wafer surface along the entire circumference of the wafer, or if the ring and wafer are not concentrically aligned, a portion of the wafer's edge may be exposed erroneously and coated with metal. Thereafter, processing steps are undertaken to pattern the wafer with semiconductor circuitry. Patterning, including selective doping through photoresist masks, deposition of blanket or selective thin film layers, and selective etching of materials, may deposit further residue particles on wafer edges, including ashed photoresist, metals such as Cu, Ta, W, TaN, Ti, etc., material from non-metallic depositions, etc. Yet another source of potential contamination is the cassettes into which wafers are loaded for transport from one processing station to another. While the aforementioned mechanical means do remove some edge residue/particles, it is often difficult to remove all edge residue/particles, and subsequent processing has been shown to redistribute edge residue/particles to the front of the wafer, causing defects.

[0004] Co-pending U. S. Patent Application Serial No. 09/113,447, having a filing date of July 10, 1998 and assigned to the present assignee, entitled "Wafer Edge Scrubber", provides an improved scrubbing apparatus having a profiled surface to more effectively mechanically remove residue/particles from the wafer's edge. While highly effective for removal of residue, an additional edge cleaning apparatus for use in conjunction with the disclosed scrubbing apparatus would further reduce edge residue/particle levels. Moreover, the scrubbing apparatus of U.S. Patent Application Serial No. 09/113,447 is not able to remove layers erroneously deposited on a wafer's edge.

[0005] Accordingly, the field of disk cleaning requires a method and apparatus which effectively removes both residue and deposited material from a disk's edge without adversely impacting the disk's major surfaces.

[0006] The present invention addresses the need for more effectively removing material from the edge of a disk by providing a method and apparatus for etching material layers and/or for cleaning residue from the edge of a disk. In a first aspect, an etchant is applied to the disk's edge via an absorbent swab into which a fluid supply line extends. The swab is placed in contact with the disk's edge and the etchant is supplied via the fluid supply line as the disk is rotated. Given the potential for the etchant to drip and thereby come into contact with patterned areas of the disk as the disk rotates away from the etchant supply (e.g., away from the swab), a rinsing fluid source (e.g., a trough or a nozzle) is positioned to remove the etchant from the disk's edge.

[0007] In a second aspect an etchant is supplied to the disk's edge via an etchant filled trough in which the edge of a vertically oriented disk is submerged. The trough may include a transducer which enhances material removal by imparting megasonic energy to the etchant. Thus, in the first and second embodiments, the invention uniformly etches material from the edge of the disk without the particle generation often experienced by the edge rings conventionally employed to prevent edge deposition.

[0008] In a third aspect, cleaning fluid is applied tc the disk's edge via a cleaning fluid filled trough in which the edge of a vertically oriented disk is submerged. The trough includes transducers which enhance cleaning by imparting megasonic energy to the cleaning fluid. An optional swab may be positioned such that the disk's edge is contacted by the swab prior to reaching the trough or after leaving the trough. The swab loosens and/or removes particles which may be continuously flushed from the surface of the swab via a fluid supply line which extends into the swab.

[0009] Each aspect of the invention may be used alone, or with any other cleaning apparatus that rotates a vertically oriented disk. Particularly, to provide the combined cleaning of both scrubbing and megasonics in a single step, the inventive cleaning trough may be used with a vertically oriented scrubber such as that dis-

closed in commonly assigned U.S. Patent Application Serial No. 09/113,447, filed July 10, 1998, the entire disclosure of which is incorporated herein by this reference. Thus, the invention may be used to remove deposited material layers from disk edges and/or may provide superior edge cleaning by combining both scrubbing via the swab or via a vertical scrubber, and megasonic cleaning via the inventive trough. The invention is particularly well suited for removing material from semiconductor substrates (silicon or a processed substrate having layers thereon) and for removing material from electroplated disks. For instance, during copper electroplating, it is difficult to ensure that no copper is deposited on the edge of the wafer. Because the barrier layer deposited prior to copper electroplating often is of insufficient thickness or continuity at the wafer's edge, any copper deposited thereon can diffuse into the wafer via the edge, degrading the electrical performance of devices being fabricated on the wafer. The present invention allows for the complete removal of copper from the wafer's edge. Similarly, tungsten can be inadvertently deposited on the wafer's edge. Because the adhesion layer at the wafer's edge is often of insufficient thickness or continuity, tungsten deposited on the wafer's edge will often have poor adhesion. Due to poor adhesion, and also due to tungsten's high internal stress, the wafer's edge can be a source of tungsten particles which may fall upon the wafer surface during subsequent processing. The present invention allows for the complete removal of tungsten from the wafer edge.

[0010] Other objects, features and advantages of the present invention will become more fully apparent from the following detailed description of the preferred embodiments, the appended claims, and the accompanying drawings.

FIG. 1 is a side view of a first aspect of the invention which applies etchant via a swab;
FIG. 2 is a side view of a second aspect of the invention which applies etchant via a trough; and
FIG. 3 is a side view of a third aspect of the invention which applies cleaning fluid via a megasonic trough such as the trough of FIG. 2.

[0011] FIG. 1 is a side view of a first aspect of an inventive system lla which applies etchant via a swab 13. The inventive system lla comprises a plurality of rollers 15a-c for supporting a disk, such as a semiconductor wafer 17, in a vertical orientation. The rollers 15a-c preferably have a v-shaped notch in which the semiconductor wafer 17 rides with minimal contact with the semiconductor wafer 17's major surface. The swab 13 comprises a liquid supply line such as a tube 19 having an absorbent material 21 mounted on the end thereof. Preferably the end of the tube 19 has a plurality of perforations the size and number of which are selected so as to maintain the absorbent material 21 at a desired level of saturation. The absorbent material 21 is made of a sponge-like material that can retain fluid (i.e., is absorbent), is wear resistant, so as to aid in material removal by mechanical abrasion, and elastic, so as to conform to the surface profile of the semiconductor wafer 17's edge.

[0012] The swab 13 is positioned to avoid the possibility of etchant dripping (e.g., due to gravity) onto the major surface of the semiconductor wafer 17. Thus, the tube 19 is preferably positioned along the lower half of the semiconductor wafer 17's edge. Similarly, a rinsing fluid stage, such as a rinsing nozzle 23, is positioned to rinse etchant from the semiconductor wafer 17 before the portion of the semiconductor wafer 17 having etchant thereon, rotates to a position where etchant may contact the major surface of the semiconductor wafer 17 (e.g., due to gravity). Thus the rinsing nozzle 23 is preferably positioned along the lower half of the semiconductor wafer 17's edge, and is preferably below the swab 13.

[0013] The rollers 15a-c are coupled to a motor 25 which causes the rollers 15a-b to rotate in a direction R. The motor 25, the swab 13 and the rinsing nozzle 23 are each operatively coupled to a controller 27 which controls the rotational speed of the rollers 15a-c, and the rate of fluid flow through the tube 19 and the rinsing nozzle 23.

[0014] In operation, the swab 13 is positioned so as to contact the semiconductor wafer 17 a fixed distance from its edge (e.g., 1-2 mm), and so as to contact the semiconductor wafer 17 with light pressure (e.g., < 1psi) so as to aid in material removal without causing the absorbent material 21 to wear at an unacceptable rate. The motor 25 is engaged and causes the rollers 15a-c and the semiconductor wafer 17 positioned thereon to rotate at a desired speed. The speed is selected so that etchant will remain in contact with the semiconductor wafer 17's edge long enough to etch a desired thickness of material therefrom, prior to encountering rinsing fluid from the rinsing nozzle 23. A supply of etchant specific to the material to be removed is operatively coupled to the tube 19 of the swab 13. For example, to remove silica slurry, a source of hydrofluoric acid is preferably employed, to remove copper a source of hydrochloric or nitric acid is preferably employed and to remove tungsten a source of ammonium hydroxide and hydrogen peroxide is preferable employed. However, any chemical which has a reasonable etch rate of the material to be removed (> 100A°/min.) could be used.

[0015] As the semiconductor wafer 17 rotates, etchant is supplied to the tube 19 and seeps through the perforations (not shown) into the absorbent material 21, and a rinsing fluid, such as deionized water, is supplied through the rinsing nozzle 23. The material (which the etchant is selected to etch) is etched as each area of the semiconductor wafer 17 rotates between the swab 13 and the rinsing nozzle 23. The abrasive contact between the absorbent material 21 and the semiconductor wafer 17 is also believed to facilitate material removal,

as the spongy swab material necessarily has a slightly abrasive effect which assists the chemical etching process. The etchant, which is chosen to etch a specific material from the edge of the disk, is continuously injected to the swab.

[0016] Due to the fact that the etchant would also remove the specific material from the major surface of the semiconductor wafer 17, it is important to keep the etchant away from the wafer's major surface. One mechanism for removing and/or neutralizing the etchant is via the rinsing nozzle 23 which sprays fluid with a sufficient flow rate to rinse the etchant from the edge, or to otherwise neutralize the etchant. Thus the rinsing nozzle 23 prevents over etching. That is, the rinsing fluid nozzle prevents etchant from contacting the major surface of the semiconductor wafer 17 (e.g., via gravity or via centrifugal force) for a period of time sufficient to etch the disk's major surface, and/or to prevent excess etching along the disk's edge (e.g., etching of insulating layers or of the silicon substrate).

[0017] Another mechanism for removal of the etchant-contaminant chemistry is the roller immediately adjacent to the tube and swab, roller 15c of FIG. 1. The roller may be fabricated of an absorbent material, chosen to be inert to the etchant, and may additionally include a rinsing fluid source and/or a vacuum means for continual removal of the etchant-contaminant chemistry, as represented in phantom by the rinsing fluid supply line R, the vacuum line V and the fluid analyzer A. Yet another means for removal of the chemistry is to include a rinsing fluid trough, such as that shown at 31 of FIG. 2.

[0018] While the swab 13 is shown as positioned to contact a portion of the wafer's edge before that edge portion rotates onto the adjacent roller, and the rinsing nozzle 23 is positioned between the first and second rollers 15a, 15b, other positions are possible as long as the etchant-contaminant chemistry is removed before it etches semiconductor wafer 17's major surfaces. To accommodate different etchants, more than one etchant station (i.e., tube and swab station), may be included. Additional rinsing stations may be included as needed. If the etching is conducted after each stage of disk processing, a single etchant station should be sufficient. However, if all etching is to be conducted after final processing, multiple etching stations may be preferred.

[0019] FIG. 2 is a side view of a second aspect of the invention which applies etchant via a trough 31. The trough 31 is positioned between a pair of rollers 15a, 15b, like those of FIG. 1. An etchant supply line 33, and an etchant outlet line 35 are operatively coupled to the trough 31. Preferably, the etchant supply line 33 is coupled to the trough 31 at a position before the semiconductor wafer 17 enters the trough 31, and the etchant outlet line 35 is coupled to the trough 31 at a position after the semiconductor wafer 17 exits the trough 31. A rinsing fluid station, such as a rinsing fluid nozzle 37, is positioned to rinse etchant from the semiconductor wafer 17 before the portion of the semiconductor wafer 17 having etchant thereon, rotates to a position where etchant may contact the major surface of the semiconductor wafer 17 (e.g., due to gravity). Thus, the rinsing fluid nozzle 37 is preferably positioned along the lower half of the semiconductor wafer 17's edge, and along the side of the semiconductor wafer 17 which exits the trough 31. The trough 31 may also contain one or more optional transducers 39 position to direct sonic energy through the etchant to the edge of the semiconductor wafer 17.

[0020] Like the embodiment of FIG. 1, the rollers 15a-b are coupled to a motor 25 which causes the rollers 15a-b to rotate. The etchant supply line 33, the etchant outlet line 35, the rinsing fluid nozzle 37 and the motor 25 are each operatively coupled to a controller 27 which controls the rotational speed of the rollers 15a-b, and the rate of fluid flow through the etchant supply line 33, through the etchant outlet line 35 and through the rinsing fluid nozzle 37.

[0021] In operation, a semiconductor wafer 17 is positioned on the rollers 15a-b, and a predetermined portion of the semiconductor wafer 17's edge thereby is submerged in the trough 31. The motor 25 is engaged and causes the rollers 15a-b and the semiconductor wafer 17 positioned thereon, to rotate at a desired speed in a direction R. The rotational speed is selected so that etchant will remain in contact with the semiconductor wafer 17's edge long enough to etch a desired thickness of material therefrom, prior to encountering rinsing fluid from the rinsing fluid nozzle 37. A supply (not shown) of etchant specific to the material to be removed is operatively coupled to the etchant supply line 33.

[0022] As the semiconductor wafer 17 rotates, etchant is supplied to the etchant supply line 33 and rinsing fluid such as deionized water is supplied through the rinsing fluid nozzle 37. Preferably, a continuous supply of etchant flows in the etchant supply line 33, through the trough 31 and out the etchant outlet line 35, so that material removed from the semiconductor wafer 17 does not accumulate in the trough 31 and deleteriously affect the etching process. Because some rinsing fluid may travel along the surface of the wafer to the trough 31, the etchant outlet line 35 is coupled to a drain (not shown) rather than recirculated. In order to maintain the etchant concentration in the trough 31 at a constant level, the rate at which etchant enters the trough 31 via the etchant supply line 31 is preferably at least equal to the rate at which rinsing fluid enters the trough 31. Thus, the material (which the etchant is selected to etch) is etched as each area of the semiconductor wafer 17 rotates between the trough 31 and the rinsing fluid nozzle 37.

[0023] As the semiconductor wafer 17's edge emerges from the etchant in the trough 31, the semiconductor wafer 17's edge is rinsed via the rinsing fluid nozzle 37, to prevent any remaining etchant from dripping onto the semiconductor wafer 17's major surface, and to neutralize and/or rinse away any remainder of the etchant material. Similar to the tube and swab arrangement de-

scribed with reference to FIG. 1, different etchants may be sequentially flowed through the trough 31, to specifically etch several layers of deposited material. The optional transducers 39 may be energized to further enhance material removal, as further described with reference to a third aspect of the cleaning system shown in FIG. 3.

[0024] FIG. 3 is a side view of a third aspect of an inventive system 11c which applies cleaning fluid via a trough such as the trough 31 of FIG. 2. The inventive system 11c is configured like the inventive system llb of FIG. 2, except that the trough 31 itself is filled with cleaning fluid, and the rinsing fluid nozzle 37 is therefore omitted. Additionally, the transducers 39 optionally contained within the trough 31 of FIG. 2, are required in the inventive system 11c of FIG. 3. Because the inventive system 11b and inventive system 11c are otherwise identical, description of the specific components are not repeated.

[0025] In operation the transducers 39 are energized, and the motor 25 is engaged and causes the rollers 15a-b, and the semiconductor wafer 17 positioned thereon, to rotate at a desired speed in a direction R. The speed is selected so that the semiconductor wafer 17 remains in contact with the trough 31's sonically energized cleaning fluid long enough to remove the undesirable material from the semiconductor wafer 17's edge.

[0026] As is well known, energizing the transducer 39 by applying an oscillating voltage thereto, causes the transducer 39 to expand and contract. The transducer 39's expansion and contraction causes cavitations or bubbles within the cleaning fluid. The bubbles expand and contract, thereby gently scrubbing the surface of the semiconductor wafer 17. The frequency at which the transducer 39 oscillates maximizes particle removal efficiency but does not damage the semiconductor wafer 17, e.g., 500kHz to 2MHz. Due to a known effect, the megasonic power density increases at the air/liquid interface as the semiconductor wafer 17 is dragged through the air/liquid interface. Therefore, as the semiconductor wafer 17 is rotated through the trough 31, the cleaning fluid air/liquid interface scans the circumference of the semiconductor wafer 17 and removes material (e.g., slurry particles, cassette residue, ashed photo resist, etc.) therefrom.

[0027] Preferably the cleaning fluid is deionized water or another such liquid which maximizes the electrostatic repulsion between the material to be removed and the semiconductor wafer 17. For example, to remove silica slurry from a disk having a negative charge (e.g., a silicon oxide coated wafer), a preferred cleaning fluid liquid is dilute NH4OH with H_2O_2.

[0028] The foregoing description discloses only the preferred embodiments of the invention, modifications of the above disclosed apparatus and method which fall within the scope of the invention will be readily apparent to those of ordinary skill in the art. For instance, the swab pictured herein is merely exemplary; other shapes may be employed, such as a curved swab shaped to contact an elongated portion of the substrate's circumference and/or to contact both surfaces of the disk. Likewise, although the trough pictured herein is preferred as it is shallow and therefore conserves rinsing fluid, other trough configurations may be employed. The disk may be supported by mechanisms other than the rollers disclosed, and the motor and the rotateable rollers which scan the disk past the etchant and rinsing fluid stations may be replaced with a stationary disk support, and a motorized etchant and rinsing fluid station which scan the disk's edge. Thus, as used herein, scanning the etchant or rinsing fluid station relative to the thin disk, encompasses moving the disk and/or the respective station. Although not shown, other disk orientations (e.g., horizontal) may be employed. The swab and trough are preferred etchant stations; however, other less preferred embodiments will fall within the scope of the invention. For instance, a capillary tube may be positioned sufficiently close to the disk's edge, and the flow rate of etchant through the capillary, and the rotational speed of the disk can be adjusted so that a meniscus of etching fluid forms on the edge of the disk. The meniscus will maintain etchant on the disk's edge and prevent etchant from flowing onto the disk's major surface. Finally, it will be understood that the trough or swab may be positioned so as to remove material from any desired region of the disk's edge (e.g., any distance from the disk's edge).

Claims

1. An apparatus for removing material from the edge of a thin disk, comprising:

   a disk support adapted to support a thin disk;
   an etchant station positioned to supply etchant to the edge of a disk supported by the disk support;
   a rinsing station positioned to rinse etchant from the edge of a disk supported by the disk support, so as to avoid over etching; and
   a mechanism for scanning the etchant station relative to the edge of a thin disk positioned on the disk support.

2. The apparatus of Claim 1 wherein the etchant station comprises an absorbent swab positioned to contact the edge of a disk supported by the disk support, and a supply line for supplying etchant to the absorbent swab.

3. The apparatus of Claim 2 wherein the rinsing station comprises a nozzle.

4. The apparatus of Claim 2 wherein the disk support is adapted to support a vertically oriented disk, and

the rinsing station comprises a trough for containing rinsing fluid.

5. The apparatus of Claim 4 wherein the trough comprises a fluid supply line and a fluid outlet line positioned to flow rinsing fluid from the fluid supply line, across the edge of a disk supported by the disk support, to the fluid outlet line.

6. The apparatus of Claim 4 wherein the trough comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

7. The apparatus of Claim 1 wherein the disk support is adapted to support a vertically oriented disk, and the etchant station comprises a trough for containing etchant.

8. The apparatus of Claim 7 wherein the trough comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

9. The apparatus of Claim 7 wherein the trough comprises an etchant supply line and an etchant outlet line positioned to flow etchant from the etchant supply line, across the edge of a disk supported by the disk support, to the etchant outlet line.

10. The apparatus of Claim 8 wherein the trough further comprises a fluid supply line and a fluid outlet line positioned to flow rinsing fluid from the fluid supply line, across the edge of a disk supported by the disk support, to the fluid outlet line.

11. An apparatus for removing material from the edge of a thin disk, comprising:

a disk support adapted to support a vertically oriented disk;
a rinsing trough positioned so that the edge of a disk supported by the disk support is positioned within the trough; and
a mechanism for rotating a disk positioned on the disk support.

12. The apparatus of Claim 11 wherein the trough comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

13. The apparatus of claim 11 wherein the trough comprises a fluid supply line and a fluid outlet line positioned to flow rinsing fluid from the fluid supply line, across the edge of a disk supported by the disk support, to the fluid outlet line.

14. The apparatus of Claim 13 wherein the trough further comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

15. In thin disk processing, an improvement comprising etching material from the edge of the disk.

16. The improvement of Claim 15 wherein etching comprises applying an etchant to a portion of the edge.

17. The improvement of Claim 15 wherein etching comprises providing a liquid etchant to a portion of the edge.

18. The improvement of Claim 17 wherein providing a liquid etchant comprises:

providing a trough containing a liquid etchant;
introducing a portion of the edge of the disk into the liquid etchant in the trough;
rotating the disk to bring successive portions of the disk's edge into contact with the liquid etchant in the trough; and
rinsing the liquid etchant from the disk's edge as the disk rotates so as to prevent etchant from etching portions of the disk other than the disk's edge.

19. The improvement of Claim 18 further comprising imparting sonic energy to the liquid.

20. The improvement of Claim 16 wherein providing etchant comprises the steps of:

infusing at least one absorbent member with etchant;
contacting a first portion of the disk's edge with the absorbent member;
rotating the disk to bring successive portions of the disk's edge into contact with the absorbent member; and
rinsing the etchant from the disk's edge as the disk rotates so as to prevent etchant from etching portions of the disk other than the disk's edge.

21. The improvement of Claim 20 wherein rinsing etchant from the disk's edge comprises spraying rinsing fluid on the disk's edge.

22. The improvement of Claim 21 wherein rinsing etchant from the disk's edge comprises introducing the disk's edge into a rinsing fluid containing trough.

23. The apparatus of claim 2 wherein the disk support comprises a plurality of rollers, and wherein the rinsing station comprises a rinsing fluid source coupled

to one of the plurality of rollers, so as to supply rinsing fluid therethrough.

24. The apparatus of claim 23, wherein the roller through which the rinsing fluid is supplied further comprises a vacuum mechanism.

25. The apparatus of claim 23, wherein the vacuum mechanism is further coupled to a fluid analyser.

26. An apparatus for removing material from the edge of a thin disk, comprising:

a disk support adapted to support a think disk;
an etchant station positioned to supply etchant to the edge of a disk supported by the disk support;
a rinsing station positioned to rinse etchant from the edge of a disk supported by the disk support, so as to avoid over etching; and
a mechanism for providing relative movement between the edge of a thin disk positioned on the disk support and the etchant station.

27. The apparatus of claim 26, wherein the etchant station comprises an absorbent swab positioned to contact the edge of a disk supported by the disk support, and a supply line for supplying etchant to the absorbent swab.

28. The apparatus of claim 26 or claim 27, wherein the rinsing station comprises a nozzle.

29. The apparatus of claim 26 or claim 27, wherein the disk support is adapted to support a vertically oriented disk, and the rinsing station comprises a trough for containing rinsing fluid.

30. The apparatus of claim 29, wherein the trough comprises a fluid supply line and a fluid outlet line positioned to flow rinsing fluid from the fluid supply line, across the edge of a disk supported by the disk support, to the fluid outlet line.

31. The apparatus of claim 29 or claim 30, wherein the trough comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

32. The apparatus of claim 27, wherein the disk support comprises a plurality of rollers, and wherein the rinsing station comprises a rinsing fluid source coupled to one of the plurality of rollers, so as to supply rinsing fluid therethrough.

33. The apparatus of claim 32, wherein the roller through which the rinsing fluid is supplied further comprises a vacuum mechanism arranged to suck fluid from the roller.

34. The apparatus of claim 33, wherein the vacuum mechanism is further coupled to a fluid analyzer.

35. The apparatus of claim 26, wherein the disk support is adapted to support a vertically oriented disk, and the etchant station comprises a trough for containing etchant.

36. The apparatus of claim 35, wherein the trough comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

37. The apparatus of claim 35 or claim 36, wherein the trough comprises an etchant supply line and an etchant outlet line positioned to flow etchant from the etchant supply line, across the edge of a disk supported by the disk support, to the etchant outlet line.

38. An apparatus for removing material from the edge of a thin disk, comprising:

a disk support adapted to support a vertically oriented disk;
a rinsing trough positioned so that the edge of a disk supported by the disk support is positioned within the trough; and
a mechanism for rotating a disk positioned on the disk support.

39. The apparatus of claim 38, wherein the trough comprises a transducer positioned to direct sonic energy to the edge of a disk supported by the disk support.

40. The apparatus of claim 38 or claim 39, wherein the trough comprises a fluid supply line and a fluid outlet line positioned to flow rinsing fluid from the fluid supply line, across the edge of a disk supported by the disk support, to the fluid outlet line.

41. A method of processing a thin disk having a pair of closely spaced planar main faces, and a curved peripheral face providing the edge of the disk and joining the two main faces, the method including the step of etching material from the edge of the disk.

42. The method of claim 41, wherein etching comprises applying an etchant to a portion of the edge.

43. The method of claim 42, wherein etching comprises providing a liquid etchant to a portion of the edge.

44. The method of claim 43, wherein providing a liquid etchant comprises:

providing a trough containing a liquid etchant; introducing a portion of the edge of the disk into the liquid etchant in the trough;
rotating the disk to bring successive portions of the disk's edge into contact with the liquid etchant in the trough; and
rinsing the liquid etchant from the disk's edge as the disk rotates so as to prevent etchant from etching portions of the disk other than the disk's edge.

45. The method of claim 44 further comprising imparting sonic energy to the liquid.

46. The method of claim 42, wherein providing etchant comprises the steps of:

infusing at least one absorbent member with etchant;
contacting a first portion of the disk's edge with the absorbent member;
rotating the disk to bring successive portions of the disk's edge into contact with the absorbent member; and
rinsing the etchant from the disk's edge as the disk rotates so as to prevent etchant from etching portions of the disk other than the disk's edge.

47. The method of claim 46, wherein rinsing etchant from the disk's edge comprises spraying rinsing fluid on the disk's edge.

48. The method of claim 46, wherein rinsing etchant from the disk's edge comprises introducing the disk's edge into a rinsing fluid containing trough.

FIG. 1.

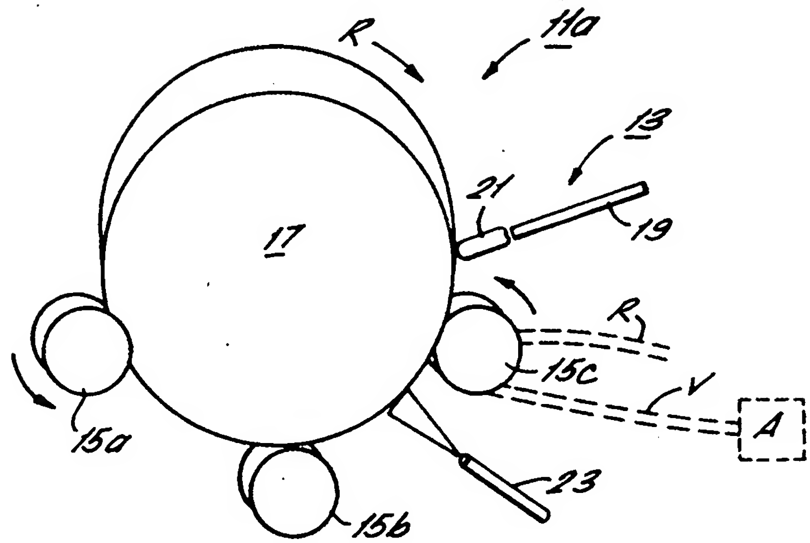

FIG. 2.

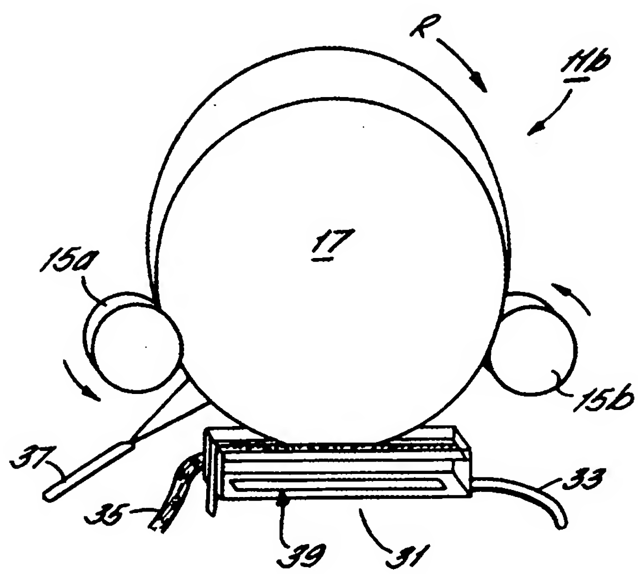

FIG. 3.